# Chapter 1

## Background and General Discussion

This Chapter briefly discusses industrial accidents involving chemicals and petrochemicals and cites some of the historical data on the number of accidents involving these products. In addition, this Chapter discusses both thermal radiation and blast overpressure, the rationale for calculating acceptable separation distances, and how that rationale applies to people and property. Although there may be a few terms used in this discussion that the reader may find unfamiliar, the majority of the terms and their definitions are covered in more detail in Chapter 2.

Industrial accidents involving chemicals and petrochemicals which result in injury to the public and damage to property are unforeseeable events that occur on a daily basis. The frequency of these events and the probability of such events occurring in the future was derived from historical data obtained from several sources, including the National Fire Protection Association (NFPA) and the U.S. Fire Administration of the Federal Emergency Management Agency (FEMA). The petroleum industry uses many protective and preventive measures designed by the industry and by NFPA to mitigate or attenuate the hazards associated with their operations. In spite of these efforts, the record indicates that there are many incidents each year involving stationary chemical and petrochemical facilities.

When an accident occurs the release of substances may result in an explosion, a fire, or both, and in some instances, toxic releases are not discussed in the Guidebook. In the case of explosion or fire, the Guidebook uses the terms blast overpressure and thermal radiation, respectively. Thermal radiation (heat) can be absorbed by the surroundings causing severe burn injuries, possibly death to people, as well as igniting combustible structures such as wooden houses and trees all at some distance from the actual fire. The standards for determining an acceptable separation distance (ASD) for thermal radiation are based on the ignition of wooden structures and level topography (terrain). Wooden buildings, window drapes, and trees will ignite when exposed for a relatively long period of time to thermal radiation flux levelers of approximately 10,000 BTU/ft2 hr. At that intensity, it takes approximately 15 to 20 minutes for a wooden structure to ignite. Therefore, a standard of 10,000 BTU/ft2 hr is considered the acceptable level of thermal radiation for buildings.

Human exposure to thermal radiation levels of 1,500 BTU/ft2 causes intolerable pain after 15 seconds. Longer exposure results in blistering, permanent skin damage and even death. Considering this relatively short period of time, 15 seconds, it is quite possible that the handicapped, children, or the elderly would not be able to take refuge in a timely manner. As a result, the standard for unprotected outdoor areas where people congregate has been established at a lower radiation level of 450 BTU/ft2 hr. Exposure to this degree of thermal radiation for a prolonged period of time has limited deterimental effect – the same as a bad sunburn. Therefore, unprotected outdoor areas, (parks, open space, playgrounds etc.) must be located at such a distance from the potential hazard that the radiation flux level will not exceed 450 BTU/ft2 hr. Exceptions can be made if the outdoor areas are shielded by existing intervening buildings, the terrain, or the proposed project building.

In summary, there are two ASD standards for thermal radiation: 10,000 BTU/ft2 hr for the siting of buildings and 450 BTU/ft2 hr for people in unprotected outdoor areas of congregation or recreation.

The criteria for determining acceptable separation distances for blast overpressure from explosive material is based on the equivalent blast predicated by TNT. The method of comparison, also known as the "TNT Equivalent," is used because the blast overpressure produced by 1 pound of TNT is known. The blast overpressure of an explosion is measured in pounds per square inch (psi). Research conducted by the military services determined that 0.5 psi is an acceptable level of blast overpressure for both people and buildings. At this level people will probably not be injured (especially if located inside a building) and no major structural damage will result to buildings, with the exception of broken windows. Based on this research, HUD adopted the standard 0.5 psi as the acceptable level of blast overpressure for calculating the ASD for both buildings and occupants.

Like the thermal radiation standards, the blast overpressure standards are predicated on a wooden frame structure and level topography. For some chemicals and petrochemicals the fire (thermal radiation) ASD will have the greatest radius, for others it will be the explosion (blast overpressure) standard which determines the greatest ASD. Therefore, when computing acceptable separation distances, the hazard requiring the greatest separation distance must be used to determine the ASD location of the proposed project site. "Acceptable separation distance" requirements are designed to insure that neither people nor property are located so close to a hazardous material of an explosive or flammable nature that injury to people or damage to property is unavoidable.

Industrial accidents involving storage tanks can result in injury to people and damage to property when the location of projects fails to consider its proximity to hazardous facilities.